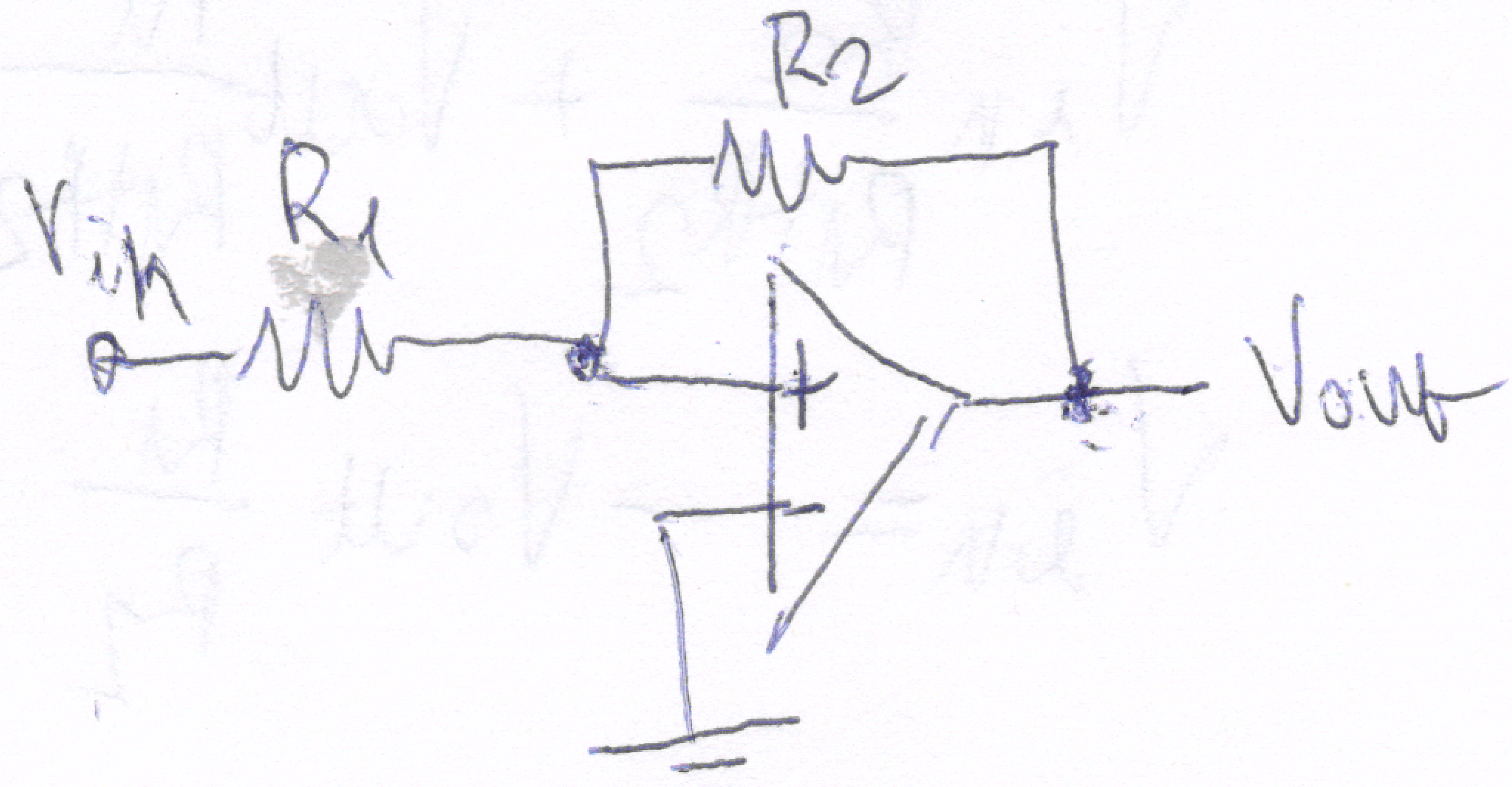
1) Naponski novo logičke jedinice je V_{OH}=2 V, a logičke nule V_{OL}=-2 V. Odrediti elemente neinvertujućeg Šmitovog komparatora tako da:

   a) gornji prag okidanja bude 1 V, donji prag okidanja 0 V.

   b) gornji prag okidanja bude 0 V, a donji prag okidanja -1V.



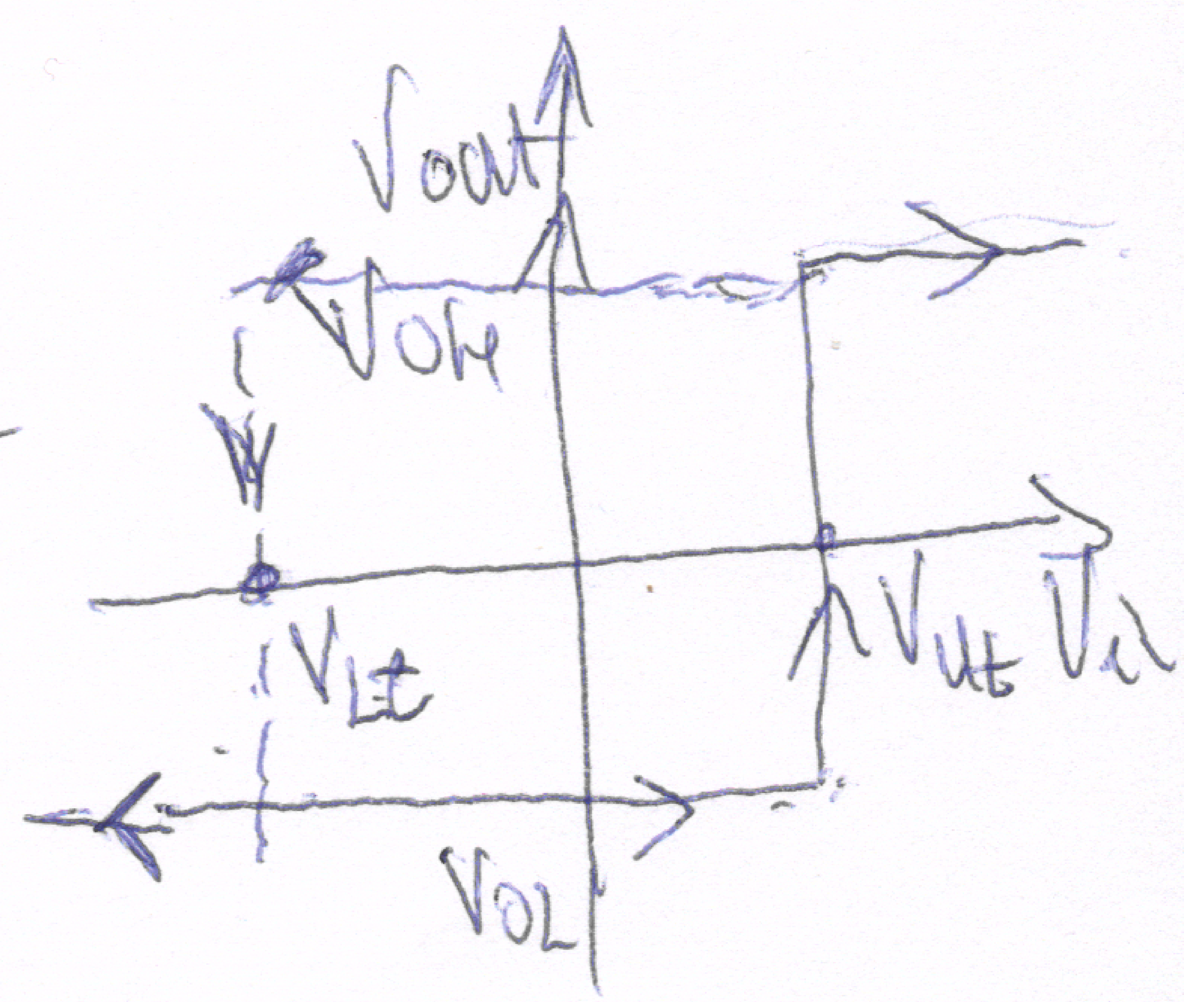
$$V^+ = \frac{R_2}{R_1+R_2}\cdot V_{in} + \frac{R_1}{R_1+R_2}\cdot V_{out}$$

$$V_{out} = V_{OL}$$

$$\frac{R_2}{R_1+R_2}\cdot V_{in} + \frac{R_1}{R_1+R_2}\cdot V_{OL} = 0$$

$$V_{in} = -\frac{R_1}{R_2}\cdot V_{OL}$$

$$\boxed{V_{ut} = -\frac{R_1}{R_2}\cdot V_{OL}}$$

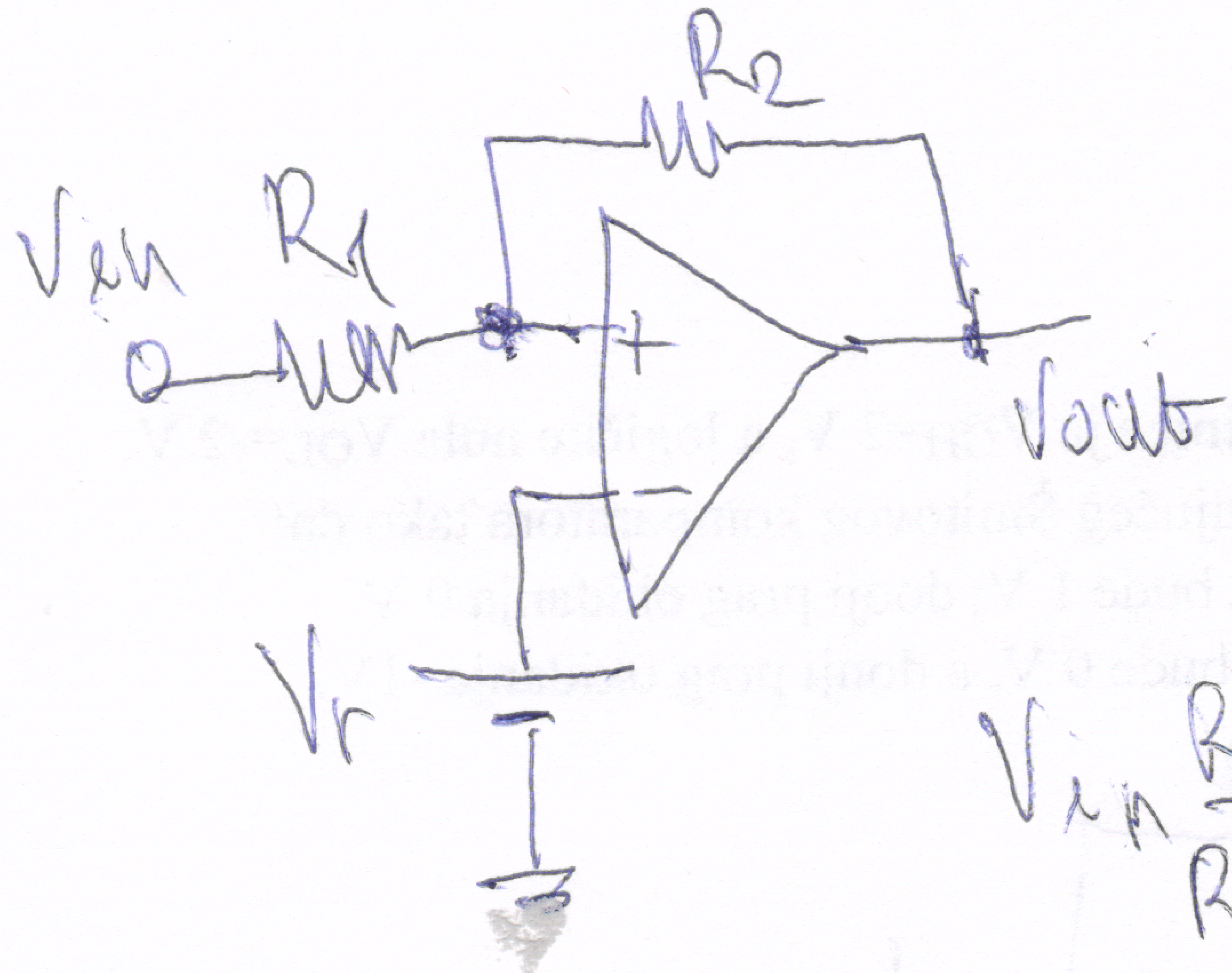


$$V_{out} = V_{OH}$$

$$\frac{R_2}{R_1+R_2}\cdot V_{in} + \frac{R_1}{R_1+R_2}\cdot V_{OH} = 0$$

$$V_{in} = -\frac{R_1}{R_2}\cdot V_{OH}$$

$$\boxed{V_{Lt} = -\frac{R_1}{R_2}V_{OH}}$$



$$V_{in}\frac{R_2}{R_1+R_2}+V_{out}\frac{R_1}{R_1+R_2}=V_r$$

$$V_{in}=-V_{out}\frac{R_1}{R_2}+\left(\frac{R_1+R_2}{R_2}\right)V_r$$

$V_{out}=V_{OL}$

$$V_{Ut}=-V_{OL}\frac{R_1}{R_2}+\left(1+\frac{R_1}{R_2}\right)V_r$$

$V_{out}=V_{OH}$

$$V_{Lt}=-V_{OH}\frac{R_1}{R_2}+\left(1+\frac{R_1}{R_2}\right)V_r$$

$V_{Ut}=1V \quad V_{LT}=0V$

$$V_{Ut}-V_{Lt}=V_{OH}\frac{R_1}{R_2}-V_{OL}\frac{R_1}{R_2}=1V$$

$$V_{Ut}-V_{Lt}=(V_{OH}-V_{OL})\frac{R_1}{R_2}=1$$

$$\boxed{\frac{R_1}{R_2}=\frac{1}{4}}$$

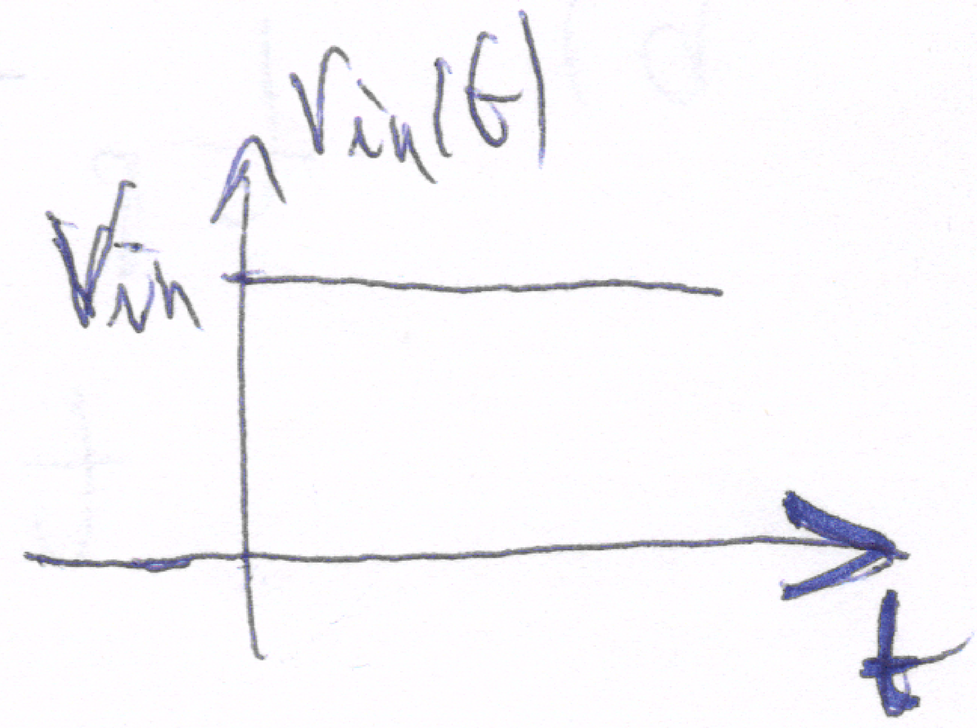
$$V_r\left(1+\frac{R_1}{R_2}\right)-V_{OH}\frac{R_1}{R_2}=0$$

$$V_r=0{,}5V\cdot\frac{4}{5}=0{,}4V \qquad \boxed{V_r=0{,}4V}$$

2) Dominantni pol komparatora je na frekvenciji $\omega_p = 10^3$ rad/s, jednosmerno pojačanje komparatora je $A_0 = 10^4$ a slurejt 1V/μs. Ukoliko se naponski nivo logičke jedinice i logičke nule razlikuju za 1 V, odrediti vreme odziva komparatora na signal čija je amplituda

a) Vin=10 mV
b) Vin=0,2 V

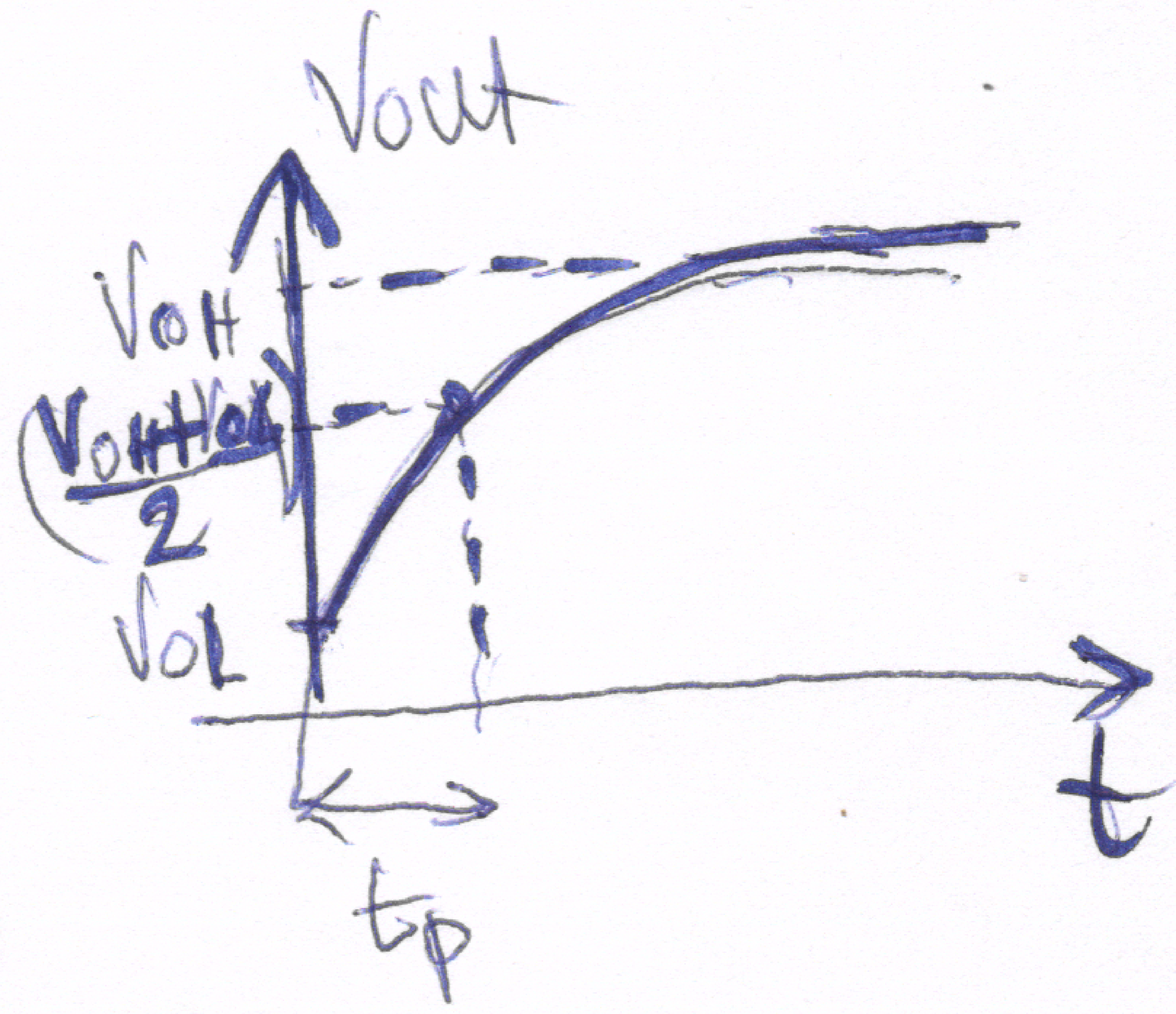
$$A(s) = \frac{A_0}{1+\frac{s}{\omega_p}} = \frac{A_0}{1+s\cdot\tau_p}$$



$$V_{out}(s) = A(s)\cdot V_{in}(s)$$

$$V_{in}(s) = \frac{V_{in}}{s}$$

$$V_{out}(s) = \frac{A_0}{1+s\tau_p}\cdot\frac{1}{s}$$



$$V_{out}(t) = \mathcal{L}^{-1}\left\{\frac{A_0}{1+s\tau_p}\cdot\frac{1}{s}\right\}$$

$$V_{out} = A_0\cdot V_{in}\left(1-e^{-\frac{t}{\tau}}\right)$$

$$A_0\cdot V_{in}\left(1-e^{-\frac{t_p}{\tau_p}}\right) = \frac{V_{OH}+V_{OL}}{2}$$

$$e^{-\frac{t_p}{\tau}} = \left(1-\frac{V_{OH}+V_{OL}}{2A_0\cdot V_{in}}\right)$$

$$t_p = \tau\cdot\ln\frac{2A_0V_{in}}{2A_0V_{in}-(V_{OH}+V_{OL})} = 10^{-3}\ln\frac{2\cdot10^4\cdot10^{-2}}{2\cdot10^2-1}$$

$$t_p = 5{,}01\,\mu s$$

$$t_{p\,min} = \frac{V_{OH}-V_{OL}}{2\cdot SR} = \frac{1}{2\cdot 10^{6}} = 0{,}5\cdot 10^{-6}\,s$$

$$t_{p\,min} = 0{,}5\ \mu s$$

b) $t_p = 2{,}5\cdot 10^{-7} = 0{,}25\ \mu s$

$t_p < t_{p\,min}$

$t_p = t_{p\,min} = 0{,}5\ \mu s$